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DEPARTMENT OF AGRICULTURE.

SPECIAL REPORT.

REPORT

ON

JUTE CULTURE,

AND THE

IMPORTANCE OF THE INDUSTRY.

By PROF. S. WATERHOUSE,
SAINT LOUIS, MO.

WASHINGTON:
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JUTE CULTURE.

By Prof. S. Waterhouse,
Washington University, Saint Louis, Mo.

The recommendations of the Department of Agriculture first attracted my attention to this fiber, and the personal observations of a visit to India have only confirmed my sense of its national importance.

Jute has been cultivated in India for hundreds of years, but it is only within the last half century that it has entered largely into the commerce and industries of foreign nations. In the culture of jute, a warm, humid climate is essential to success; but the physical characteristics of the soils in which the plant flourishes greatly vary. It thrives with an almost equal luxuriance upon highlands or alluvial bottoms. It will grow upon comparatively dry uplands or in flooded valleys. But it prefers a high, moist, sandy loam. Alluvial mold in which there is a liberal admixture of sand is favorable to its growth, but a very dry or a very sandy soil is not adapted to this tillage.

The land intended for this crop is usually broken up in the fall. With unwearied industry, the natives plow the land over and over again—in some instances as many as twenty times—until the soil has been thoroughly pulverized, deeply exposed to sun and air, and richly manured. The seed is sown broadcast, from 20 to 30 pounds to the acre.

The time of sowing varies with the conditions of soil and climate. In the northeastern provinces of Bengal, where nearly all of the jute of India is raised, the seed is sown in February, March, and April. In the vicinity of Calcutta the seed is often planted as late as July. Sometimes two crops are raised in a season, but this is too exhausting to the soil. After the jute has come up, it is carefully thinned and then left, without much further tillage, to ripen. It matures in twelve or fifteen weeks. The plant sometimes grows to the height of 20 feet, but its average height is 10 or 12 feet, and the diameter of the butts varies from half an inch to an inch and a half. One variety which is extensively cultivated has a smooth white bark and wide-spreading branches. In the northern provinces of Bengal the average yield is from 2,000 to 3,000 pounds an acre; in the neighborhood of Calcutta it is from 500 to 1,000 pounds. In the north of the Bengal Presidency the quantity of seed raised per acre is 1,000 or 1,100 pounds; in the south it is 1,400 or 1,500 pounds. The jute is cut while the plant is in flower, because the fiber is then more glossy and less woody. The seed ripens one month

after flowerage, and the fiber has then become so woody as to lose much of its commercial value. After cutting, the jute is usually kept two or three days, till the leaves fall off, and then it is immersed in water. The period of submersion varies, according to the temperature and character of the water, from three or four days to a month. The methods of steeping practiced by the natives are various. The fiber prepared in clear running water is strong, white, and glossy; the process, however, lasts for several weeks. But when the jute is soaked in stagnant water, although the disintegration is usually effected within ten days, yet the fiber is apt to be weaker and more discolored. But in either case the action of the water is to loosen the fibrous bark from the woody stalk. The natives test the jute from day to day, and when they find that the bark is ready for removal, they enter the water and withdraw the stems by a succession of jerks. Their reason for effecting this separation in the water is that the soft and even pressure of the fluid prevents the rupture of the fibers. After its removal the inner bark is stripped of its rind, freed from all woody adhesions, thoroughly washed, and immediately dried. It then readily separates into minute fibers, and is ready for the market or for domestic spinning.

In the provinces where jute is raised the distaff is in every hovel. The Mohammedans, deterred by some religious scruple, restrict themselves to the manufacture of cotton; but all Hindoos of the industrial classes, robust men, in the intervals of other employments; children, too young for severer tasks; the aged, too infirm for hard work; invalids, incapable of active exertion; and even the despised Hindoo widow, whose social degradation and misery powerfully appeal to the sympathies of Christendom for relief, engage in the spinning and weaving of jute. The manufacture of this staple, utilizing the leisure hours of the strong and dexterous handicraft of the weak, affords occupation to the myriads; but wages are so extremely low and the competition of industries so limited, that jute-yarn and gunny-cloth can be purchased almost as cheaply as an equal weight of the crude material. No portion of this substance is wasted. The leaves and ashes are used for manure, the stalks for baskets and fuel, the seed for oil and oil-cake, the roots for fuel and paper, and the silky floss which escapes from the fibers in the process of manufacture is wrought into hats.

Till recently the government of India has never fostered the cultivation of jute; but without its patronage this industry has, within the last half century, risen to a world-wide importance. In 1828 the total foreign sale of jute was less than 40,000 pounds, worth $300. Now, Calcutta, which is the great point of distribution, exports immense quantities of this staple to Bombay, Madras, Ceylon, Burmah, Singapore, Penang, Java, Australia, Brazil, the west coast of South America, France, Great Britain, and the United States. Only about one-fourth of the crop is reserved for domestic consumption. According to the fashion of the different countries, pepper, coffee, sugar, rice, cotton, soda, lime, the

matte and regulus of the precious metals, and many other articles of commerce, go to market in a dress made of gunny-cloth.

The statistics of the development of the jute-culture in India are impressive and suggestive. In 1862, India exported 10,000,000 pounds of fiber and rope and 300,000,000 yards of gunny-cloth. In 1863, Great Britain employed more than 30,000 spindles in spinning 80,000,000 pounds of Indian jute. Recently this staple has arisen to the dignity of the fourth place in the exports of India; only cotton, opium, and rice exceed it in commercial importance. Some of the Indian factories are immense. There is an establishment at Barnagpoor, near Calcutta, which employs more than 4,500 workmen, and annually manufactures more than 30,000,000 pounds of jute. In 1872, the total exportation of Indian jute was 700,000,000 pounds, of which Great Britain received upward of 395,000,000 pounds. In the same year more than 900,000 acres were devoted to the cultivation of jute in India; and in the thirteen provinces in which jute is principally raised, out of a population of 15,725,000, more than 1,350,000 were wholly or partially engaged in this occupation. These figures conclusively show the vast magnitude and importance of this industry to India. Other statistics will illustrate the value of this staple to an exclusively manufacturing community.

Nearly half a century ago some sagacious Scotchmen engaged in the manufacture of jute. Their humble experiment has developed into a success that has enriched Scotland and promoted the commerce of the world.

At first many difficulties arrested their progress. Much of the fiber was discolored by the tannic acid of the bark, through improper methods of preparation; and it was only after years of persistent effort that a successful process of bleaching was discovered.

Again, the fiber stubbornly resisted the action of dye-stuffs, and over this difficulty chemical science has yet only partially triumphed. Jute can now be dyed, but the colors are not fast. Still the variety of tints now imparted to jute permits it to be combined with other materials in cheap imitation of many valuable fabrics.

Jute is mixed with cotton, linen, and silk. It is a material part of twilled stair-carpeting and low-priced broadcloth. In combination with other textiles, it imitates the gloss of Irish linen, the luster of French silk, the beauty of Turkish rugs, and the splendor of Axminster, Kidderminster, Brussels, and Venetian carpets. Single or mixed, it enters into the manufacture of a thousand articles of commerce. In 1872, there were in Dundee about one hundred jute-mills, employing upward of 20,000 workmen, and manufacturing more than 180,000,000 pounds of jute annually. In the same year nearly 50,000,000 gunny-bags—most of which were made in Dundee—were exported from Great Britain. Of the 300,000,000 pounds of jute that were manufactured in the United Kingdom in 1876, 200,000,000 pounds were woven in the mills of Dundee. The annual value of the flax, hemp, and jute manufactured in

Dundee is now $15,000,000. The jute factories of Dundee have created a flourishing city, given employment to thousands of workmen, diffused prosperity throughout a large community, promoted the commerce of Scotland in the importation of the raw material and the exportation of the manufactured product, and facilitated the movement of the cotton and grain crops of the world.

What has been so successfully accomplished in Dundee can be done with a still grander success in the United States.

We not only can spin and weave the fiber, but we can also raise it.

We not only can derive the profits of making the fabrics, but we can also enrich ourselves by the twofold economies of the growth and manufacture of the staple.

Under the auspices of the Department of Agriculture, experiments in the culture of jute have been successfully tried in South Carolina, Florida, Georgia, Louisiana, and Texas. These trials conclusively established the fact that wherever in the Southern States there is a hot, damp climate, and a moist soil of sandy clay or alluvial mold, jute can be profitably raised. It is probable that much of the land now devoted to the growth of cotton, rice, and sugar-cane would yield larger returns if applied to the culture of jute. The plant matures in this country in about the same time that it does in India. The April plantings were cut in July, and the June plantings were cut in September. Some of the stalks reached the height of 15 feet, and in some instances the fiber was, according to the judgment of experts, superior in strength to that of India.

The yield was in several cases at the rate of 3,500 pounds to the acre. These facts, so familiar to the Department of Agriculture, are here repeated for the information of those who have not seen the results of the experiments inaugurated by it. The trials that have been made strengthen hope into an assurance that jute can be successfully cultivated in the Gulf States and in Southern California.

The conditions of soil and climate and the practical tests of experiment are here so favorable as seriously to alarm the government of India. The official report of an Indian commission appointed by the state has expressed a grave apprehension of American competition in the culture of jute.

It is to be hoped that the enterprise of the South will prove that this apprehension was well grounded.

The economic importance of this culture to the United States is incalculable.

No country in the world is capable of deriving so vast a benefit from this industry as our own. The magnitude of our grain and cotton crops is unparalleled in other lands.

In 1870 the quantity of cereals and vegetables produced in the United States, and requiring to be sacked before they could be sent to market, was largely more than 1,500,000,000 bushels. Ultimately this vast mass

was handled in bulk by elevators, barges, canal-boats, railroads, and steamships; but before it could be brought from the various points of production to these facilities of transportation it had to be inclosed in bags. If it were necessary to renew these bags every year, it would now cost the United States $100,000,000 annually for its grain, pulse, and potato sacks. This calculation is based upon the assumption that all the bags are made of jute. If the material were cotton, flax, or hemp, the expense would be still greater. But as the sacks last several years, the annual cost is not probably one-fifth of the above aggregate. In 1876, the cotton crop of the United States was about 4,500,000 bales, and at the ruling rates the cost of the gunny-cloth in which this cotton was sent to market was not less than $3,900,000.

Unlike the grain-sacks, the jute baling cannot be used a second time, and therefore a wholly fresh supply is necessary every year. Our native production of fibers is greatly inadequate to meet the demand. In 1868, the United States paid $23,000,000 for imported flax, hemp, and jute. In 1870, the cost of imported fibers was more than $30,000,000 in gold. The quantity of jute alone imported in 1870 was upward of 19,000,000 pounds. Yet these figures, although large, but imperfectly indicate the demand which there would be for jute if it were a domestic production. The cheaper fiber would, of course, be substituted for the more costly wherever it was possible, and accordingly jute, in consequence of its comparative inexpensiveness, would supplant hemp and flax in the manufacture of carpets and many other fabrics. For bagging and cotton-baling, jute has already almost entirely superseded the use of the other fibers. But possibly it will be found better, in order more fully to meet the varying needs of commerce, to interweave jute with cotton, flax, and hemp; and in that event the introduction of jute, instead of depressing, would stimulate the culture of these fibers. But the vast need of our country for grain-sacks, cotton-bale covers, and a cheap warp for a woof of other textile materials will create a correspondingly vast demand for home-grown jute. It will indicate a lack of southern enterprise if American jute does not yet rise to a textile importance second only to that of American cotton.

Heretofore the agriculture of the South has been restricted to the production of a very few staples. This narrow limitation of southern industry is an essentially false policy. The South has made the grave mistake of confining its activities almost exclusively to one pursuit. But no country can realize its highest possibilities of material greatness by following a single employment. The urgent need of the South today is a wide range of industries. It ought to superadd manufactures to a larger variety of agricultural productions. Then the competition of the different occupations would impart activity to business, give more employment to labor, create better local markets, raise the price of agricultural and manufactured products, increasing the profits of workmen,

planters, and manufacturers. and promote the well-being of the entire community.

The introduction of the growth and manufacture of jute presents a new opportunity for diversifying the industries of the Southern States. If the experiments which have been already tried in the South are a safe guide, then the profits of jute culture would amply reward the American planter.

According to the estimates of practical experience, jute-butts can be produced in the United States for 3 cents a pound in currency, and the fine fiber for 8 cents. The average price of Indian butts in this country is 3 or 4 cents a pound in gold, and the fine yarn is worth 8 or 10 cents a pound in gold. Nor is the difference between the cost of Indian and American jute the only source of profit.

There is a relative economy in the cultivation of this plant. According to southern testimony, it is four times as productive as cotton or flax, while at the same time it takes not more than one-tenth as much labor to raise it. In the manufacture of hemp and flax there is a loss of 15 or 20 per cent. of the material, while the loss in working jute is only about 9 per cent. In our markets jute-bags are worth from ¼ to ½ a cent a yard more than flax-bags. Hemp rots much quicker than jute does. The superior cheapness and durability of jute are rapidly displacing flax and hemp in low-priced manufactures.

There are also important incidental advantages of this tillage. The vigorous, luxuriant growth of the jute almost exterminates weeds from the soil in which it is sown, while the bitterness of its juice repels the attacks of insects. It has been found that cotton-fields surrounded by a belt of jute were exempt from the depredations of the caterpillar, while unprotected fields in the same neighborhood suffered from its ravages.

The profits of the domestic manufacture of jute are not unworthy of the attention of capitalists. Eighteen hundred and seventy was a year of exceptionally high prices. In that year the profit on the home manufacture of 19,000,000 pounds of jute was more than $2,000,000. Of jute fiber, butts, and rejections,* the total consumption in the United States in the last three years was over 300,000,000 pounds. At present, the average cost of jute-butts, delivered in Saint Louis, is 3 or 3½ cents, gold, per pound, and the ruling rate of the jute-baling manufactured in this city is now 12½ cents a yard in currency. From these data practical men will be able to form just estimates of the costs and profits of this manufacture. Imported gunny-cloth, generally of an inferior quality, now commands an average price of 9 or 10 cents a yard in currency;

*These are technical terms. In the language of trade, "jute-butts" are sections, 12 or 15 inches in length, of the lower end of the plant. These coarser portions are made into heavy baling and bagging. The "fiber" is the long silky yarn, which is woven into finer fabrics; and the "rejections" are parts of the "fiber," which, in consequence of being stained, tangled, or woody, are unfit for delicate manufactures. "Rejections" are commonly worked up with the butts.

but domestic bagging, although somewhat more expensive, is, in consequence of its better quality and make, usually preferred. The home manufacture of jute-baling has already become an important industry. In 1876 the mills of Saint Louis alone manufactured 6,000,000 yards of jute-bagging. The domestic growth of jute would not only benefit the producers and manufacturers, but it would also impart prosperity to other industries. It would afford an inexhaustible supply of cheap material to the paper-makers. The root-fiber and other refuse portions of the plant, and the worn-out baling, sacks, and carpets, can now be converted into a smooth, strong, white paper. During the last five years about 170,000,000 pounds of jute were made into paper in the United States. The newspapers of the United States ought actively to promote an undertaking the success of which would so greatly redound to their own advantage.

It is a costly improvidence to pay other nations for staples and products which we can raise and manufacture as cheaply as they can. For all imported jute fabrics we are now paying the cost of production in India, the freight to England, the expense of manufacture, the transportation to the United States, and the commissions of all the factors and insurance agents through whose hands the goods have passed. Millions of dollars are now annually paid to foreigners for labors that ought to be performed by Americans. We are heedless of the lessons of public economy. A diversity of employments and an industrial independence of other countries will most efficiently promote the welfare of our own people. It is the true policy of the United States to introduce and naturalize the industries of the Old World and to foster the common wealth of the nation by paying to American handicraft the millions which are now the rich reward of European skill. The English government finds it very difficult to introduce improved machinery or scientific methods into the agriculture of India. The inert masses resist innovation with a conservatism born of centuries of stagnation. The traditional implements and processes of an earlier age are still used in the tillage of India. The plows and harrows and the machines for spinning and weaving are of the rudest description. The natives are too poor to buy improved tools and too ignorant to use the better methods. They have not analyzed their soils, ascertained the best succession of crops, tested the different systems of fertilization, or improved their primitive processes of preparing and manufacturing their staples. In fine, their labor is unintelligent, and therefore ineffective and unthrifty.

An industial comparison of our Southern States with India greatly encourages our hopes of success in this new industry. The labor of the South is far more intelligent than that of India, and it is constantly under skillful guidance. The southern planters will not follow an antediluvian style of agriculture. In India the best soil is usually devoted to raising jute for the market, and the poorer land is left for the pro-

duction of jute-seed. The natural consequence of this course is the deterioration of the seed. In the United States, on the contrary, a portion of the best land has been reserved for seed, and the result is a signal improvement in the quality of the seed. American jute-seed is one-sixth heavier than that of India. The broadcast sowing of Bengal is uneven and wasteful. Our patent drills, saving 10 or 15 pounds of seed to the acre, do the work with far greater rapidity and equality of distribution. The efficiency of our agricultural machinery will more than neutralize the seeming advantage which India possesses in the cheapness of its manual labor. It would take tens or hundreds of Indian hands to do the work of one American machine.

It will be strange indeed if the mechanical ingenuity which in some departments of manufacture has triumphed over the cheap skilled labor of Europe and enabled the United States profitably to export to the great centers of industrial art watches, cutlery, agricultural implements, coarse domestics, and some finer fabrics, cannot win a far greater victory over the unskilled hand-labor of India. It is high time for a general introduction of the culture of jute in our Southern States. Every step in the progress of naturalization should be attended by intelligent experiment. Tests of every kind of soil and treatment will result in better seeds, a larger yield, a rotation of crops that will be least exhausting to the soil, machines for the cheap and rapid removal of the bark of the plant, and processes of steeping that will separate the fiber without destroying its strength, color, or gloss. Then the new enterprise, giving employment to home labor and activity to domestic capital, will quicken the revival of our languishing industries, aid the South in regaining its material prosperity, and enrich the nation by the economy of millions which have heretofore been paid to foreign lands.

The foregoing article on "jute culture" appeared in the Annual Report of this Department for the year 1876. The industry is regarded as one of sufficient importance to warrant the republication of this paper in connection with a more recent treatise on the rapid expansion of the industry, from the pen of the same writer. The article is as follows:

EXPANSION OF THE JUTE INDUSTRY.

Hon. GEORGE B. LORING,
Commissioner of Agriculture:

SIR: Your proposal to republish my article on jute, with such supplementary observations as later experience suggests, was as unexpected as it is gratifying. The tender of my cordial acknowledgments for so distinguished a favor is accompanied with an earnest hope that this re-

print will not be wholly ineffective in promoting the development of an industry whose productive value may yet rival the economic importance of cotton.

It is now six years since the foregoing article on jute was originally published.

It may be instructive to glance at the surprising changes which have taken place in this brief period.

EXPANSION OF THE JUTE TRADE.

In 1878 the writer visited Dundee. The city presents an impressive spectacle of manufacturing greatness. The massive walls which surround the jute factories resemble the ramparts of extensive fortifications. The streets are shaded with a forest of lofty chimneys. Throughout the city there are on all sides conspicuous proofs of the great prosperity which a single industry has created.

Of late the jute mills of India have been dangerous competitors. English intelligence employing the cheap labor of Bengal has obtained control of adjacent markets. Formerly most of the jute goods which the far east consumed were manufactured in Dundee, but now the demands of the Oriental trade are supplied by the factories of India.

In the report of Consul Winter there is a tabulated statement of the number of gunny-bags exported from Calcutta from January 1 to August 31, 1881. In order to show how extensively this element of eastern commerce has been diverted from Scotland, some of these statistics are reproduced; but only the largest aggregates, quoted with the inexactness of round numbers, are here given. This partial table of the jute bags exported from Calcutta is as follows:

Destination:	Number.
South Africa	1,100,000
Australia, New Zealand, &c	3,000,000
Hong-Kong and San Francisco	17,750,000
Burmah, Straits and coast ports	25,340,000

But notwithstanding this vast loss of patronage, the manufacturers of Dundee have been steadily extending their business; though the number of factories remains about the same, their capacity of production has been materially enlarged; more than 30,000 hands are now employed in the jute mills of Dundee. In consequence of the ever-widening range of uses to which the fiber is applied, the consumption of jute is increasing all over the world.

The consular report above cited states that, with the single exception of Russia, jute factories have been established in every country of Europe. But in 1879 the exportations of jute to Great Britain, France, and the United States amounted to more than 730,000,000 pounds. If the consumption of three countries reached this aggregate, it would presumably be safe to conclude that the total exports to all lands are now not less than 800,000,000 pounds.

But India itself manufactures about 200,000,000 pounds. Late estimates place the present annual production of Indian jute at from 1,000,000,000 to 1,200,000,000 pounds. In the absence of recent statistics, it is impossible to ascertain the exact amount; probably these estimates are too high.

Ten years ago intelligent observers foresaw the present greatness of the jute industry. In 1872 Mr. George Burnet, of Scotland, visited India and examined the sources of supply. He says:

Believing, as we do, that the jute trade is the most expansive of any trade now in existence, and that within the space of the coming ten or fifteen years in India, Great Britain, America, and the continent, five or six millions of bales may be required annually, we see no reason to doubt that Bengal and British Burmah can easily and without displacing any other article of necessary consumption produce all that the growing trade requires. It is very apparent, however, that the present mode of growing and treatment and preparation is very rude and faulty. It is very difficult to introduce improvements amongst a class so widely scattered, having such small holdings as the ryots have and will continue to have.

Again, in 1873, he writes:

The trade in jute is one of the most expansive in the world. During the last quarter of a century it has progressed steadily and rapidly, until in the year 1866 the exports of jute, together with jute rejections and cuttings, reached 638,908 bales, while in 1871 it amounted to 1,644,311 bales. Last crop exceeds that in quantity, and it will all be required.

At the present time jute goods cannot be produced fast enough to meet the demand. Mills and factories are being increased in Great Britain and India, and are also being erected in Australia, America, and the continent of Europe. At the end of the coming decade the wants of the whole trade will likely reach four to five millions of bales annually.

Though Mr. Burnet's expectations were somewhat too sanguine, his prediction of a vast expansion of the jute trade evinced no lack of forecast.

The agricultural development of the United States in the last half dozen years has been marvelous. Our cotton crop is now 6,750,000 bales, and the total yield of cereals is 2,700,000,000 bushels.*

The production of vegetables which are carried to market in sacks is almost illimitable. The demand for bagging has enormously increased. The baling of the cotton crop of the United States in 1882 consumed more than 100,000,000 pounds of jute. The product of the factories of Saint Louis has risen from 6,000,000 yards of bagging in 1876 to 13,000,000 yards in 1882, and, to meet the greater demand, several jute mills have recently been built in the Southern States.

The coarse webs just mentioned are the cheapest goods into which jute is ever manufactured. The finer fiber is wrought into an almost infinite variety of elegant and costly imitations.

Allusion was made in the former article to the beauty of these luxu-

* The summaries of the field products of 1882 are not yet quite complete, but the above figures, which are sufficiently exact approximations, are sanctioned by the statistician of the United States Agricultural Department.

rious fabrics. Their novelty and number are constantly increasing, but while from the want of accurate data the total worth of these rich textures is incalculable, yet any estimate which fails to recognize their enormous value would be eminently unjust to the textile importance of jute.

But it is not necessary to replace all the statistical illustrations of the former article with statements of present production. The latest agricultural reports of India are not yet accessible; and the intelligent reader, familiar with the recent statistics of American products, will be able to make the proper substitutions, and to observe with how much greater force the larger facts of to-day urge the establishment of the new industry in this country.

It is obvious from the preceding figures that jute is, next to cotton, the most important vegetable fiber in the world.

The greater part of this surprising development has taken place in the last quarter of a century.

LUXURIANT GROWTH OF JUTE IN THE UNITED STATES.

An interest in the economic welfare of the United States naturally suggests the inquiry whether an industry productive of so great affluence cannot be established in this country? The substantial identity of climate and soil in some districts of Bengal, and certain sections of the South, created a presumption that jute could be naturalized in the Gulf States. This probability, practical tests have strengthened into certainty. Hundreds of successful experiments have shown the ease with which jute can be raised in the Southern States. The results of many of these trials have been published in the reports of the Department of Agriculture. The accounts which, in return for distribution of seed, have been personally received would fill many pages. They are unanimous in their testimony. They prove beyond the possibility of intelligent doubt that, under proper conditions of soil and moisture, jute thrives on the borders of the Gulf with great luxuriance. But few of the tropic weeds, whose noxious exuberance seems to be in inverse ratio to their value, exceed it in rankness of growth. Some of the reports assert that jute can be raised as easily as Indian corn.

In 1881 Mr. Drummond, of the British legation at Washington, deemed the subject of jute culture in the United States worthy of a special report to the English Government. He says:

> Experiments were made in those (Southern) States, which proved that the cultivation and preparation of these fibers (ramie and jute) is practicable and profitable.
>
> Last year 1,500 packages of seed were distributed to the farmers in Louisiana, and reports have come in that the jute plant flourishes in every parish, growing in the alluvial soil to a height of 15 feet, and in the pine flats and on the hills to 10 and 12 feet.
>
> Now this is interesting to us, for all manufacturing countries have been dependent upon India for their supply of jute.

There is no need of further experiments to corroborate what has been

so fully demonstrated. It is now a well established fact that jute flourishes as luxuriantly in the United States as in India, and experts have testified that the fiber, when properly prepared, is quite equal to that of Bengal. If, then, the effort to introduce the culture of jute into this country is unsuccessful, the failure will not be due to the fact that the plant will not grow on American soil.

NEED OF MACHINERY.

From the outset some rapid and economical process for the removal of the fiber has been an indispensable condition of the prosperity of the jute industry in this country. In India the wages of adults are 10 or 15 cents a day. In exceptional cases of strength or skill the workman may obtain a quarter of a dollar, but in the rural districts where jute is raised the average pay for rude labor is probably not more than one-half of this sum. In the United States wages are so high that any manual competition with the hand work of India must inevitably prove a failure. It has been evident from the beginning that a mechanical treatment of the fiber was the only means of success, and consequently urgent appeals have been made to the inventive genius of our countrymen to meet the demand. It was confidently believed that American ingenuity, stimulated by the motive of public usefulness, and the hope of private riches, would conquer the difficulty. The confidence was not misplaced. The problem has been solved. Mr. T. Alber Smith, of Saint Louis, has invented a machine which will enable planters to determine whether jute can be profitably cultivated in the United States.

The following is the report of the first formal trial of Mr. Smith's machine:

WASHINGTON UNIVERSITY, *Saint Louis, September* 18, 1882.

DEAR SIRS: The jute machine of Mr. T. Alber Smith was tested in this city on the 12th of September. The mechanical conditions under which the experiment was tried were imperfect. The machine was operated by an engine that was at the same time driving all the machinery of a large workshop. Hence it was impossible to determine the amount of power required to actuate the jute machine.

The jute was home grown. It was raised near Brookhaven, Miss.

As the jute was cut before it was mature, the stalks were rather small and short. Their length ranged from five to seven feet. The stalks were entirely green and untrimmed. They were put into the machine with all their branches and leaves on, just as they came from the plantation. The jute stalks weighed eighty-seven pounds. They were run through the machine in thirty minutes. The available pulleys of the machine shop were so adjusted as to afford insufficient power.

It was deemed unwise for the sake of one experiment to incur the expense of alterations. Not more than one-third of the feeding platform was at any time filled. If the power had been adequate the time consumed in passing the stalks through the machine would not have exceeded ten minutes. After the operation the blades of the machine were found to be free from gum. An ingenious and effective application of water-jets obviates a difficulty that has heretofore been very embarrassing. The separation of the fiber from the ligneous stem was complete. Hardly a sliver of wood remained among the ribbons of fiber, and wherever a piece was found it was wholly detached and easily shaken out. The machine delivered the fiber straight and un-

tangled, while traveling belts carried away the woody fragments and left them in a heap by themselves. The eighty-seven pounds of stalks yielded twenty-seven pounds of green fiber. A pound and a half of green fiber were found in the refuse, but this waste consisted almost entirely of the fiber of the branches. These were so short that the fiber was not long enough to reach from the crushing to the separating rollers, and therefore was carried through and deposited with the refuse. The machine, of course, only removes the wood from the fiber. The process of retting is still necessary before the fiber is ready for commercial use. Three experiments in retting were tried. Two of them were conducted in the laboratory of Washington University. Fourteen and one-fourth pounds of green fiber steeped in a boiling bath of chemicals yielded two and one-fourth pounds of dry fiber. Ten and a half pounds of green fiber treated by the same method produced one pound and a half of dry fiber. The time spent in this process was exactly six hours.

The fibers are strong and easily separated, but somewhat darker than those retted in water. Two and one-fourth pounds of green fiber were placed in water, but the process of retting is not yet finished.

All of the steps described in these various tests were taken under my personal supervision. These facts will enable you to judge for yourselves of the commercial value of Mr. Smith's machine. It is very gratifying to me, after ten years of urgent appeal to inventors, that one of my own townsmen has devised a machine that is an important advance towards the solution of a great industrial problem.

Mr. Smith's invention simplifies the process of preparation. Heretofore water retting required ponds and rivers for the submersion of the unwieldly mass of stalks. But Mr. Smith's machine so greatly reduces the bulk that the fiber separated from the wood can easily be treated in vats. Water seems to be the most economical solvent of the gum which holds the jute fibers together. But water will do its work as cheaply in the United States as in India. Though chemistry may yet invent more effective methods, at present the cheapest way of separating the fibers is an immersion of the jute in vats of hot water. This process, impracticable when the whole stalks are handled, is readily feasible when only the fiber is treated. Ponds and rivers cannot be heated, but vats can be, and an equable temperature of any required degree can be maintained.

Mr. Smith's machine obviates a serious difficulty. In India the entire stalk is placed in water. If the stem is thick the fiber at the top is thin and delicate, while that at the foot is coarse and dense. As the water has access only to the outside of the stalk, the thicker bark and more compact fiber at the bottom prevent a uniformity of retting. Before the fiber at the butt has been sufficiently dissolved, the fiber at the top has become worthless from overretting. But Mr. Smith's machine, by stripping away the woody part of the stalk, and freely admitting the water to both sides of the fiber, insures a comparative equality of retting and prevents a material loss of fiber.

Hoping that the culture of jute in the Gulf States will soon develop into a national industry, and cordially thanking you for your gratifying acknowledgment of my own efforts to promote the success of this great interest,

I am, very respectfully, yours,

S. WATERHOUSE.

Messrs. JAMES M. PUTNAM and C. MENELAS.

The small quantity of fiber obtained in this test was due to the immaturity of the stalks. The growth of the jute was retarded by an excess of moisture. The stems were short, slender, and unripe; being imperfectly developed, they were deficient in fiber. The poverty of results could not be ascribed to the method of treatment, for, with the exception of a surprisingly small amount of waste, the machine saved all the fiber the stalks contained.

In the following October the machine was removed to the plantation of Mr. C. Menelas, near Brookhaven, Miss. A portion of the 15 acres of jute which the proprietor had planted was expressly reserved for a second trial of Mr. Smith's machine.

It was now so late in the season that, in consequence of over-ripeness, the stalks were dry and ligneous. The jute, too woody for textile use, was worthless except for the simple purpose of a test. The machine was therefore subjected to such a trial as it would never have to encounter in actual service, for the fiber is finest when the plant is cut in the time of flowerage, and then the green and pliant stems do not expose the machinery to violent strains. But, though repeated tests were made with hard and intractable stalks, the operation of the machine was satisfactory. The severe ordeal, which its proper duty would never require it to pass, developed no serious defects. During all of the numerous trials the action of the blades was never obstructed by any adhesions of gum.

PROFITS.

The capacity of Mr. Smith's present machine is 15,000 pounds of green stalks in a day of ten hours. The day's work of the larger machines which it is proposed hereafter to build will be 30,000 pounds. The service of the machine requires three men. The inventor authorizes the statement that the total cost of raising jute and of preparing it for market by his process will not exceed 2 or 2½ cents a pound. Calculations based upon this estimate show that, even at current rates, which are exceptionally low, jute is a more profitable crop than cotton. Planters, whose long and varied experience entitles their judgments to respect, confirm the assertion. The bagging mills of the South offer for home-grown jute the same price which they have to pay for the foreign article. The freight from Calcutta to New York is now about half a cent a pound. The cost of foreign jute in the American market is still further enhanced by charges of Indian factors for purchase and packing, brokers' commissions, marine insurance, and the United States impost. All these expenses, which the American importer cannot evade, favor the domestic production of jute. Aided by mechanical facilities and a judicious tariff, the protective duty which distance imposes will mature a nascent industry into a sturdy growth.

But it is alleged that the present tariff on jute, which levies a higher rate on the crude material than on the textile product, unwisely discriminates against home manufactures. So grave a charge challenges the attention of American statesmen. To devise a protection which, with just encouragements, will foster an industry abounding in possibilities of national enrichment, is the congenial task of patriotic Congressmen. If the endeavor to introduce the new staple should ultimately fail, it would undoubtedly be wise to remove the tariff on raw jute; but till that event, which no signs at present portend, it would be an act of impolicy

and of unfriendliness to American prosperity to withdraw from a young and struggling industry the guardian care of the government.

Some planters have feared that the competition of India would prove fatal to the profits of jute culture in the United States. An illustration will show the probable groundlessness of this apprehension.

There are lands in India as rich as any the sun shines on. The luxuriance of the vegetation attests the fertility of the soil. The plains and intervals of India resemble the prairies and alluvial bottoms of the Mississippi Valley. Unlimited levies of cheap labor can be enlisted in the service of agriculture. Yet, notwithstanding the productiveness of the soil and the lowness of wages, no American planter dreads Indian rivalry in the cultivation of cotton. The quality of the Indian staple is noticeably inferior. One of the remarkable sights witnessed in a personal tour through India was thousands of acres of cotton which seemed too poor to gather. Probably something of the excellence of American cotton is attributable to peculiarities of air and soil. The exceptional favors which nature has bestowed upon the "Sea Islands" exclude their product from this general comparision. But it is not yet known how much of the qualities commonly ascribed to climatic conditions is really due to differences of cultivation. If the population of India and the United States should change places, it is not certain that Hindoostan would not obtain the supremacy in cotton-growing that the South now holds. At all events, after the most liberal allowance for the effect of atmospheric influences, the superiority of the American staple is largely due to better methods of agriculture. It is simply incredible that, on similar soil, the rude tillage of India should produce as fruitful results as the enlightened culture of the United States. The yield per acre of American cotton is not only far more abundant, but the fiber is longer and finer than that of the East Indies. India enjoys no special and exclusive facilities for raising jute. Its industrial advantages are equally favorable to the production of cotton. If, then, with all the benefits of cheap labor, it cannot maintain an ascendency in growing cotton, how can it prevent profitable competition in the cultivation of jute? In the case of both fibers, the skillful use of machinery is an essential factor of American success.

The raising of cotton is laborious and costly. From the turning of the furrow to the completion of the harvest, unremitting care is necessary to insure a plentiful crop. But the tillage of jute is easy and inexpensive. The operations after the stalks have been gathered require the greatest work and outlay. This difference increases the probability of success in the attempt to raise jute in the United States; for a large part of the toil expended upon the culture of cotton is necessarily manual. But a great portion of the work which prepares jute for the market can be performed by mechanical processes. Hence the cheap labor of India is more favorable to cotton than it is to jute; for, as in-

telligence, trained to the use of the best methods, does not exist in Hindoostan, the rude physical toil for which alone the natives are fit can be more effectively applied to the growth of cotton than to the preparation of jute. If, then, the East Indians, though aided by so signal an advantage, could monopolize the supply of cotton, is it not just to infer that a dexterous application of labor-saving machinery will enable Americans to compete with their foreign rivals in the production of jute?

The foregoing facts and reasons certainly seem to indicate that fair profits will reward the cultivators of jute in the United States.

ADAPTATION OF THE SOUTHERN STATES TO JUTE CULTURE.

In India jute is raised almost exclusively on ground that has been flooded by the annual overflow of the rivers. The alluvial deposit left by the inundation forms just the soil which the plant requires. The bottom-lands of the lower Mississippi closely resemble the jute fields of India. There are in the South extensive tracts not suited to the cultivation of sugar or cotton, but well adapted to the growth of jute. If the plant will flourish on the salt marshes that fringe the Gulf, the area of land available for this tillage is almost immeasurable. The capacity of these lands should be thoroughly tested. If suited to the production of jute, they can be converted into prolific sources of public prosperity.

In India the mass of the people has an inertia which the forces of modern civilization can but sluggishly move. Utterly unacquainted with improved processes, the native workmen plod on in the unthrifty ways of their fathers. By always sending the best jute to market and reserving the poorest for seed they have produced a marked deterioration in the quality of the fiber. The inferiority of recent products is a matter of universal observation and complaint. A desire to escape the oppressive exaction of Indian monopolists, as well as to secure better material, has led the manufacturers of Dundee to try extensive and costly experiments in Egypt. But, while the soil of the delta is well suited to the production of jute, the intellectual and industrial character of its inhabitants does not indicate a successful result. The same lethargy and indifference to modern methods which are proving so disastrous in India will in all probability insure failure in Egypt.

But the South has cheap and docile labor which can be easily trained to the requisite degree of skill. Intelligent experts, superintending every operation of the new industry, will apply to the cultivation and treatment of jute the best processes which science has discovered. Experience will determine the exact conditions of soil and moisture best adapted to the growth of the plant, and a careful selection of the seed of the finest stalks will soon improve the quality of the fiber. It is probable that, in the course of years, American grown jute will attain an excellence as high and distinctive as that of Sea Island cotton. A vigilant attention to every means of improvement cannot fail to pro-

duce a fiber of superior strength, fineness, and beauty. The yield per acre in the South has often been larger than that of India. Scientific agriculture, enriching the soil with a generous supply of plant-food and preventing its rapid exhaustion by a judicious rotation of crops, ought assuredly to develop a greater fertility than that produced by a system of ignorant and wasteful tillage.

The excellence of the fiber is generally proportioned to the freedom of the plant from branches. When there are no off-shoots, the filaments have greater length, softness, and gloss. But thick sowing seems to be the only practicable way of preventing branching. If, therefore, the seed is sown broadcast, it should be scattered with a liberal hand; but if it is planted in drills, the rows should be near each other. Then the struggle for light and air will cause the plants to grow tall, straight, and branchless.

In India the plan of planting in successive months has been tried. The example may be worthy of American imitation. If the seed were sown at intervals in April, May, and June, as the harvest would not all be gathered at one time, a less number of machines and a smaller force of workmen would be required to handle the crop. In a double sense, the smaller the plant the less would be the outlay. An income at seasons of the year when the returns of other crops are not available would not be the least important advantage which this system would confer upon the planter. The laborers, too, would obtain uninterrupted employment and regular wages during months in which they ordinarily have but little to do.

RETTING.

In India practical experience has shown that the process of retting is hastened by steeping the stalks in stagnant water. In a stream the operation takes more time, but the fiber has greater whiteness, strength, and luster. The construction of vats, while promoting cleanliness and the economic handling of the jute, would permit the use of hot water, steam, or chemicals for the removal of the gum. Chemistry, which has in modern times so usefully simplified many industrial processes, may yet reduce the time of retting to a few hours. But, unless the element of time becomes very important, water will always be the cheapest solvent. In India the average duration of retting is 10 or 15 days. So short a period will not allow the substitution of any costly process. Whatever takes the place of water must save the difference in expense by economy of time.

LABOR-SAVING FACILITIES.

In order successfully to compete with the cheap labor of India and the mechanical skill of Dundee the most efficient agencies must be employed. The plowing, planting, cultivating, and cutting should be done by the best implements which ingenuity has devised to lessen the

toils of agriculture. The ribbons of fiber, swiftly stripped from the stalks by fingers of steel, ought to be placed on large frames, which, under the control of steam, would move up and down in the retting vats like an elevator. All the processes of manufacture must be performed by the latest labor-saving appliances. It is only by such economies that Americans can hope to excel foreign competition.

If the South raises more jute than the needs of this country require, it may yet export the fiber to Dundee, as it does cotton to Liverpool. In the event of success in the cultivation of jute in this country, some of the Dundee manufacturers have intimated their willingness to establish factories in the United States.

PROSPECTS AND SUGGESTIONS.

The Americans are actively prosecuting the experimental growth of jute in various parts of their country, while we are, as a government, doing nothing to extend it.

These words, uttered in 1873 by Hon. George Campbell, the lieutenant-governor of India, have to-day a fresh and dangerous significance. The attention which the Southern States are now giving to the subject of jute-culture is deep and unexampled. The interest is akin to public enthusiasm. Never from the inception of the attempt to naturalize jute in this country have the auguries of success been so propitious. The very uncertainty of other staples strongly recommends the cultivation of the Indian plant. Cotton and sugar are not sure crops. The havoc of worms and insects often disappoint the hopes of the planter. But jute is, seemingly, offensive to these destructive pests. Its bitter and acrid qualities are said to drive them from its presence. It might, indeed, be used as a vegetable police to guard other crops from attack. If, in the discharge of its sentinel duties, it should merely shield cotton from the insidious inroads of its enemies, its cultivation for exclusively defensive service would annually save the South millions of dollars. But when, in addition to its protective virtues, jute has a textile value which is one of the world's great sources of fibrous wealth, a neglect to cultivate it would betray a culpable indifference to the prosperity of the South. A partial failure of the harvest has not infrequently taught the danger of a too great reliance upon a single staple. The planters have learned, under the costly tuition of experience, to diversify their industries. If there is only one production, its blight involves the farmer in irremediable loss; but if there is a variety of products, when one crop fails there are still other resources to retrieve the disaster. Hence, if there were no lands in the South suited to the culture of jute but those which are now allotted to cotton and sugar, it would be the dictate of economic prudence to withdraw a proportionate share from its present use and devote it to the tillage of the new staple.

The movement in favor of the proposed industry is now so earnest and widespread that it cannot stop until the question whether jute can

be lucratively grown in the United States has been definitely answered. Now, for the first time, there is a means of testing the possibility of profit by business standards, and probably thousands of planters will hasten to try the experiment. But, in order to avoid disappointment, there should be an intelligent concert of action. The cultivation of small quantities of jute on farms remote from railroads and navigable streams would hardly prove remunerative. Doubtless large estates would raise enough jute to justify the purchase of the mechanical conveniences which its preparation would require. The smaller farmers, whose limited crops would scarcely warrant the individual outlay, could combine and buy a machine. Seemingly it would be the best plan to build vats and factories in central and easily accessible places. If it were necessary for each planter to possess the costly appliances requisite for all of the operations, there could be no possible profit in the business. But, if the great bulk of the jute were removed by decortication, the compact masses of fiber could easily be sent to the factory, and there, where all the apparatus for retting and manufacturing existed, the material could be cheaply handled. By sagacious and economical co-operation the planters of the South may derive profitable returns from the culture of the Indian staple.

No vigor of language can too earnestly express my conviction that a great industry, productive of vast opulence, now awaits the hand of southern enterprise. The lapse of time has only strengthened my belief that the Southern States can, by organized effort, produce a new vegetable fiber, which, ranking next to cotton in value, will not only enrich themselves, but also increase the textile resources of the world.

With a renewed expression of my obligations for your personal courtesies, and with congratulations that your administration of the Department of Agriculture will witness the opening of a plenteous source of public wealth,

I am, very respectfully, yours,

S. WATERHOUSE.

WASHINGTON UNIVERSITY,
Saint Louis, Mo., February 15, 1883.